THE KOERTING

DOUBLE-ACTING TWO-CYCLE GAS ENGINE

BUILT BY

THE DE LA VERGNE REFRIGERATING MACHINE CO.

NEW YORK

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GAS ENGINE

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SOLE LICENSEES FOR THE UNITED STATES

FOOT OF EAST 138th STREET, NEW YORK CITY

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PREFACE

THE high thermal efficiency of the gas engine has long been recognized, but the somewhat clumsy arrangement of the four-cycle plan, even with duplication of cylinders, has never received the hearty endorsement of engineers.

We are now able to offer a gas engine which differs very little in its operation from that of a high-grade steam engine. Having the same capacity for regulation, the same flexibility, and running at the same moderate speed, it may be expected to have the same durability.

The Koerting Double-acting Two-cycle Gas Engine, herein described, has been pronounced by experts with practical unanimity to be the only one at present meeting all the requirements of practice in proper mechanical shape. Additional information, prices, etc., may be obtained by application to the sole licensees for the United States,

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NEW YORK

September, 1902

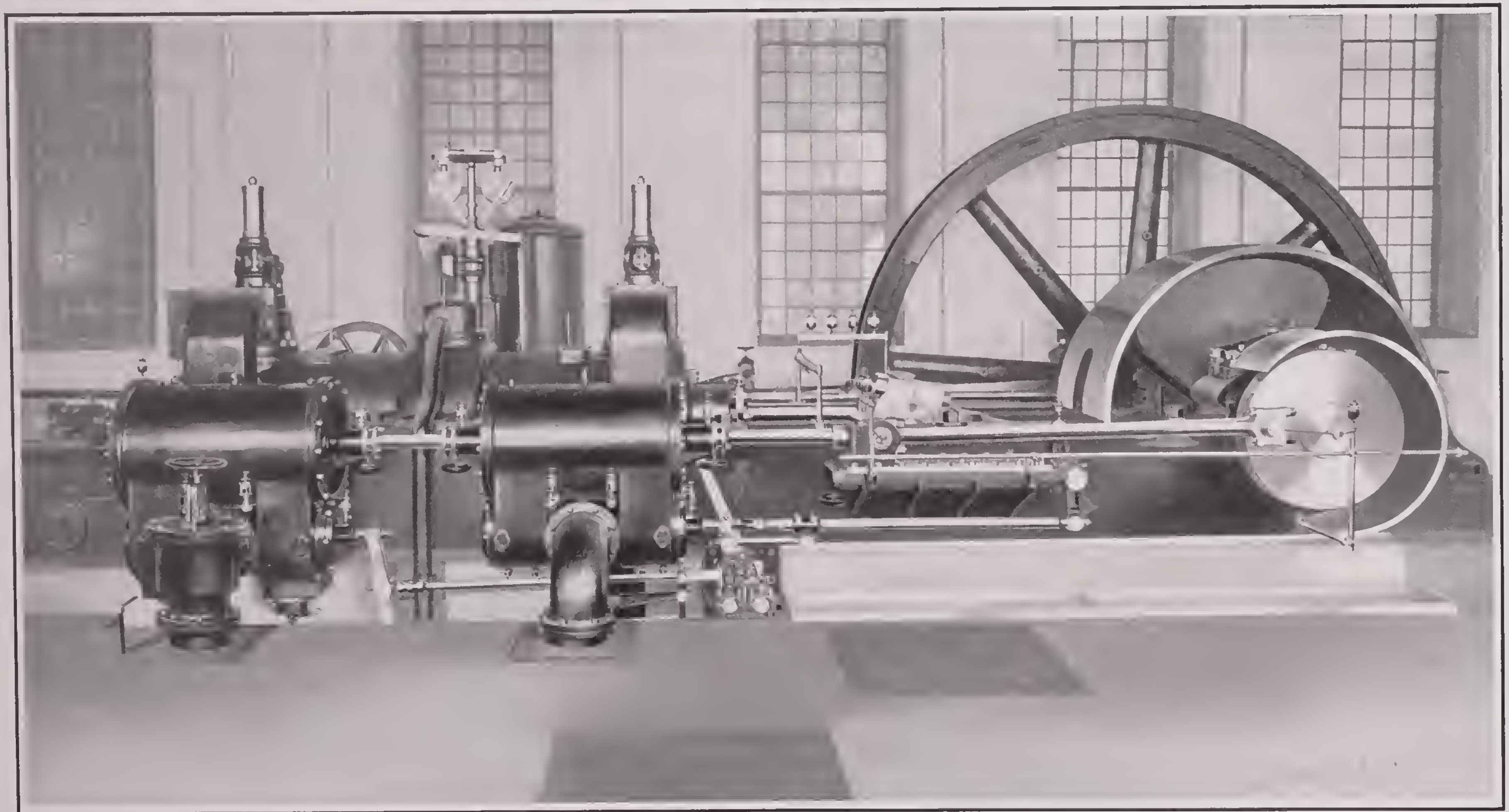
THE KOERTING GAS ENGINE. *Built by* THE DE LA VERGNE REFRIGERATING MACHINE CO., NEW YORK. *Sole Licensees for the U.S.A.*

THE discovery of the fact that gases of low heating capacity could be used effectively in gas engines has created a demand for one of higher grade than was previously called for. This demand for high-class engines was more pronounced in Europe than in this country for the reason that the relative cheapness of steam coal here prevented the general introduction of gas-producer plants.

An immense impetus to the construction of larger gas engines was given by the comparatively recent discovery that the gases given off by blast furnaces could be utilized in gas engines, and the demand for units of 1000 horse-power, 2000 horse-power and upwards, compelled a reconsideration of the design of the gas engine.

The four-cycle plan is the one generally adopted for engines of small power, because then the same piston and cylinder can be used as pump for sucking and preparing of the charge, and as power cylinder. Engines of great power, however, become very large and heavy, in fact the limit in size for building such single-cylinder engines is soon arrived at. Hence large engines have usually been built with several cylinders rather than with a cylinder of too great dimensions. The result was the so-called "tandem," "twin," and three and four-cylinder engines. Engines of these types can only be considered as a makeshift, as they are very complicated, and therefore more liable to get out of order.

In large four-cycle engines the valve boxes also present great difficulties in construction, owing to the immense valves, especially the exhaust valves, often resulting in failures. In consequence of all these considerations, many attempts have been made to design large gas engines on a different plan.



SIDE ELEVATION OF THE KOERTING ENGINE

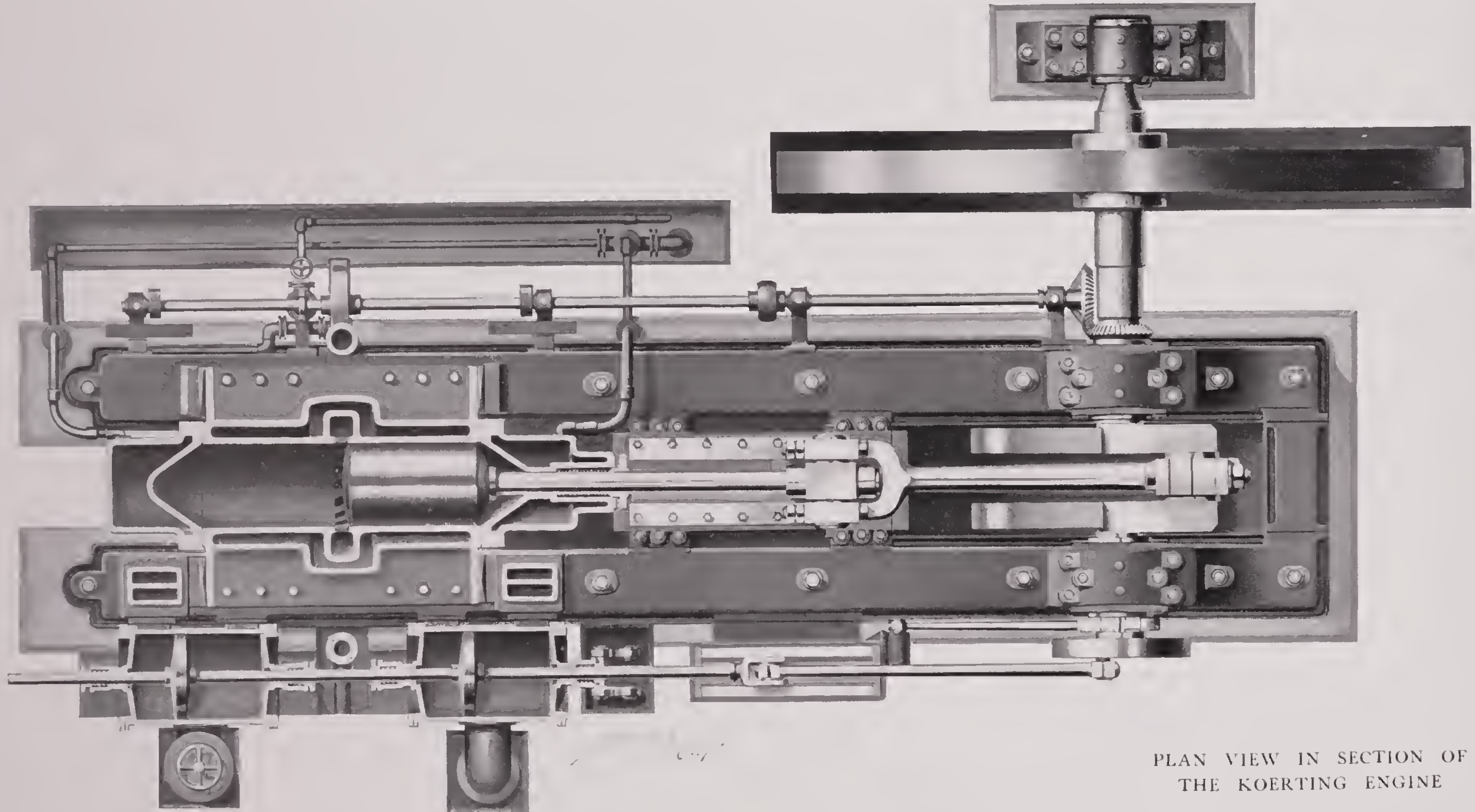
Mr. Ernst Koerting was peculiarly fitted to attack this problem. He is universally acknowledged to be an expert on all questions relating to the gas engine, and he started, therefore, with a full knowledge of the requirements of the case (his firm having built many thousand gas engines), and moreover with a practical acquaintance (which only long experience could give), with all the advantages and disadvantages of various possible constructions.

The Koerting Double-acting Two-cycle Gas Engine is the result of tests and experiments extending over a period of almost five years, conducted on models and on a 400-horse-power gas engine built in the Koerting shops. It was found that the new system complied fully with all the requirements. Thereupon they commenced to build these engines and they proved an immediate and complete success.

The method of operation of Koerting's Double-acting Two-cycle Gas Engine is as follows:

The engine is double-acting like a steam engine, hence the crank end and the head end of the power cylinder are similar, the admission valves are located in the valve boxes, which are bolted to the cylinder heads. There are no exhaust valves required, as the products of combustion escape through slots or ports cast in the middle of the cylinder from where the exhaust pipe leads. These slots are covered by the motor piston itself. For this purpose the piston is made very long and is packed at each end by the customary self-closing spring rings.

The combustible mixture is admitted through two double-acting auxiliary pumps, the one for gas, the other for air. These pumps are so proportioned that their combined action always secures the proper mixture necessary for perfect combustion and introduces the same to the working cylinder. The compression spaces of the pumps are divided, so that the crank ends of the air pump and gas pump discharge into the crank end of the power cylinder, and the head ends of the pumps discharge into the



PLAN VIEW IN SECTION OF
THE KOERTING ENGINE

head end of the power cylinder. By the pumps the gas and air are compressed to about nine pounds per square inch.

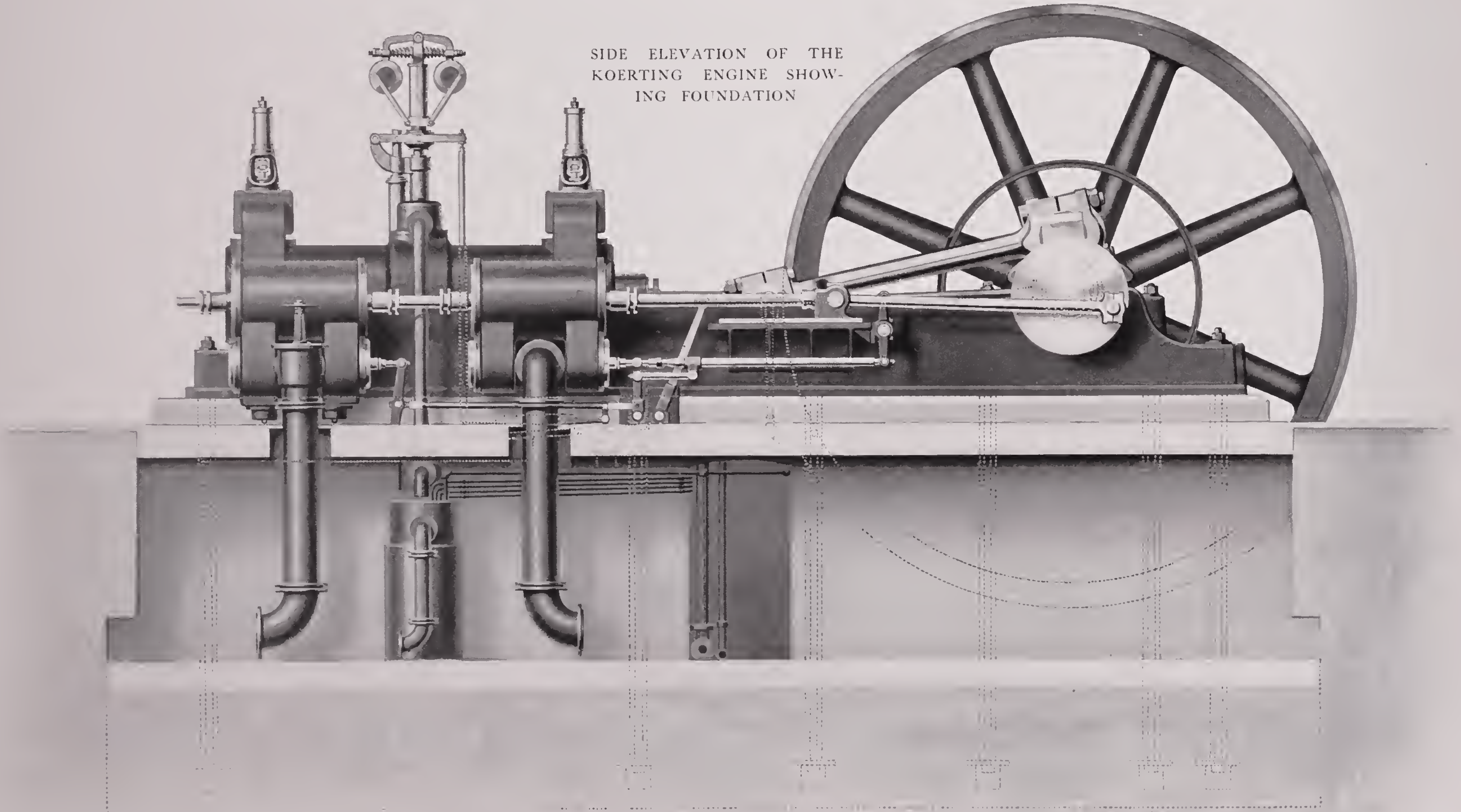
Referring to the drawing on opposite page, it will be seen that the piston is at the outer dead point, and that the exhaust ports are exposed toward the opposite or head end of the engine. The instant the piston begins to uncover the exhaust ports, the pressure of the residual products of combustion in the cylinder drops rapidly to that of the atmosphere; when this has taken place, the inlet valve is opened and a fresh charge admitted by the pumps. The valve gear of these is so designed that air only is supplied first, to separate the burnt gases from the succeeding mixture and afterwards gas and air, mixed in proper proportions. (See also page 20).

The combustible mixture of gas and air is produced only at the inlet to the cylinder (see page 14). There is no storing of it, and this represents a very considerable advantage over engines that keep more or less of the combustible mixture outside of the working cylinder. By suitable construction of the admission device, mingling of the air first introduced with the burnt residue gases, or with the succeeding charge of the combustible mixture, is adequately avoided. For the same reason, loss of mixture through the exhaust ports, which are open during this period, is effectively prevented.

Shortly after the exhaust ports are again covered by the receding piston, the air and gas pump pistons arrive also at their dead point position, and the supply of mixture is interrupted. The inlet valve closes and the charge is compressed in the cylinder in the usual method, till, at the dead point of the stroke, ignition takes place.

At the next movement of the main piston, the ignited charge exerts its driving power by expanding till just before arriving at the other dead points, when the piston uncovers the exhaust ports again

SIDE ELEVATION OF THE KOERTING ENGINE SHOWING FOUNDATION



and allows the consumed charge to be blown out. On the opposite end of the piston the same operation takes place.

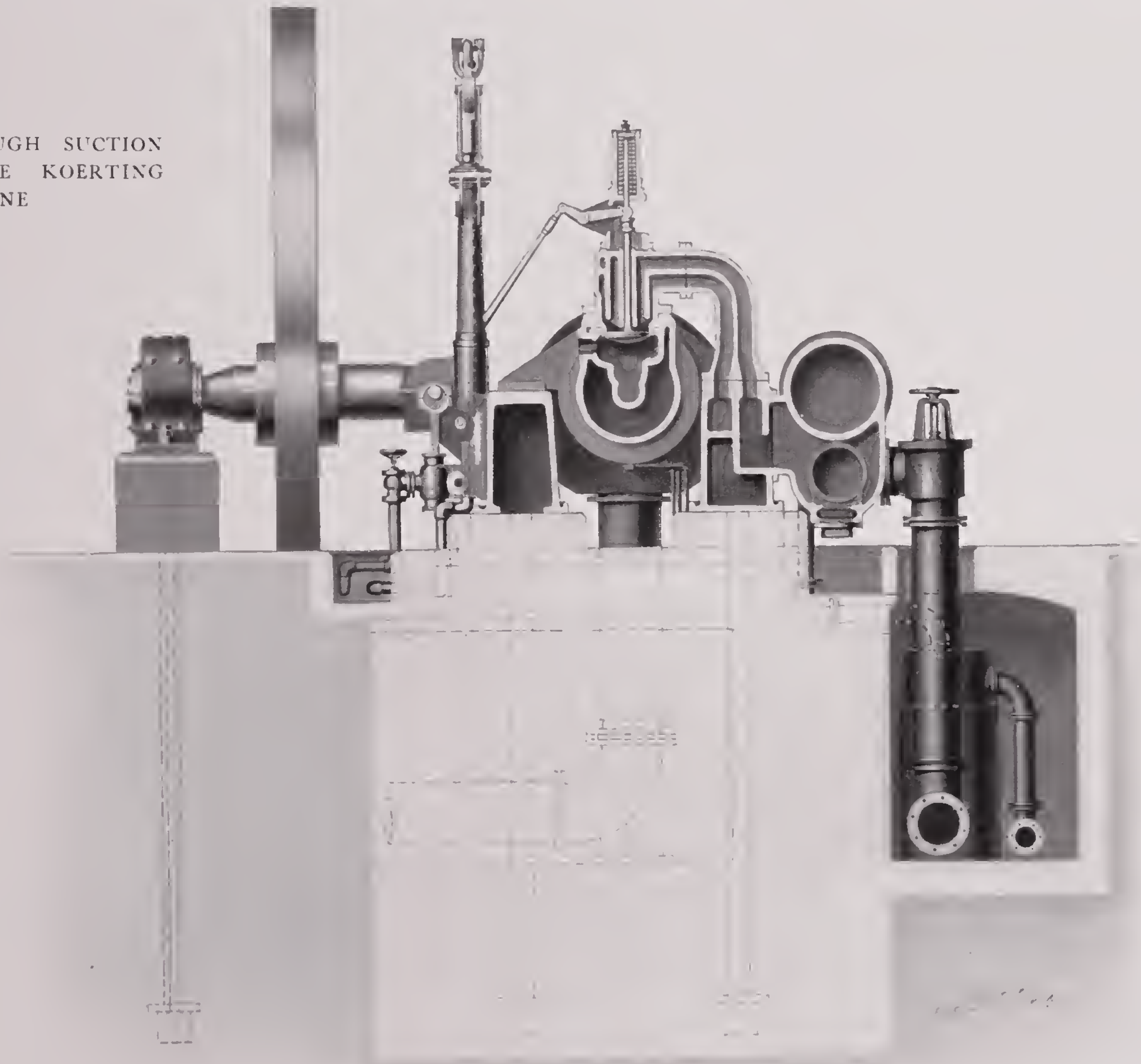
In order to secure the separating layer of air above referred to, between the hot consumed gases and the fresh charge, the gas pump is so constructed that no gas is delivered until after a certain point in its compression stroke. The pump is provided with piston valves with the valve gear so arranged that its maximum capacity cannot exceed 50 to 60 per cent. of its total displacement. For after the pump has completed the suction stroke, the gas suction port is left open during a portion of the succeeding (compression) stroke, so that the gas can return without increase in pressure until the suction port is closed, when the gas is compressed and passed out through the compression port.

The amount of gas thus furnished corresponds to the maximum power of the engine.

Regulation of the power is effected as follows: When the load on the engine is reduced, the gas pump begins to furnish gas at a correspondingly later period, thus discharging a diminished quantity of gas into the working cylinder. This is accomplished either by the valve gear of the pump and controlled by the governor, or by a by-pass located between each pump end and respective compression channel which leads to the inlet valve on the main cylinder. The throttling device in this by-pass is also under the control of the governor.

It is evident from the above, that the engine operates with a variable amount of mixture, and that correspondingly more or less air is sent first into the power cylinder. This air stays near the middle of the cylinder, while the combustible mixture remains at the heads of the cylinder near the inlet valves and igniters. The peculiar shape of the cylinder heads prevents mingling of the layer of air with the following mixture of gas and air.

SECTION THROUGH SUCTION VALVE OF THE KOERTING ENGINE

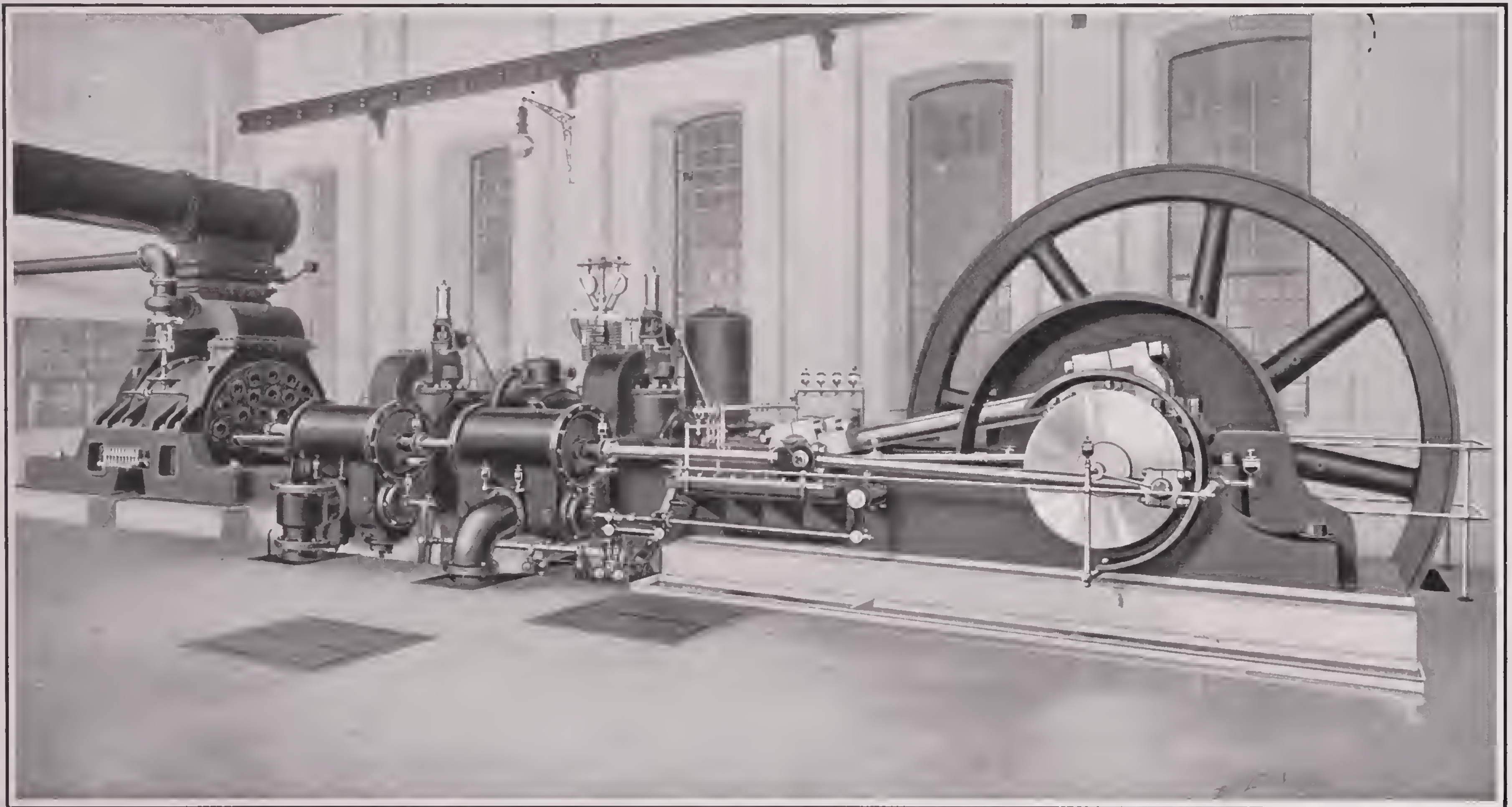


For ignition there are provided two spark coils at each end of the power cylinder. These are operated by a separate shaft, driven by spur gearing from the cam shaft. The gear on the igniter shaft is not fast, it is connected with a sleeve having a feather, which is set spirally around the shaft so that by a sliding movement of the wheel the igniter shaft may be set behind or in advance of the cam shaft. Thus the time of ignition can be changed during running of the engine to suit whatever kind of gas is being used. A further advantage secured by this arrangement is, that at starting, the point of ignition may be so set that ignition takes place only after the piston has passed the dead point, and the engine started very slowly without incurring any pre-ignition. Very lean gases require much earlier ignition than is otherwise usual. In practice, indicator cards are taken from time to time to check the timing of the ignition, and to see whether the combustion of the gases is without fault. Igniting of very poor gas mixtures presents no difficulties at all with this arrangement.

The engine is started with compressed air. Engines to which a blowing cylinder is attached are easily started with air under 150 pounds pressure, for those without such cylinders 90 to 120 pounds per square inch is sufficient.

This circumstance is of greatest importance, as this air pressure does not exceed the amount of compression under which the engine runs, namely, 150 to 175 pounds. For no compressed air can enter near the dead point position where compression of the mixture is at maximum, and so the ignition can take place without being unfavorably influenced by such air, which is thus automatically cut out.

A piston valve is provided for admitting the compressed air at front and back ends of the cylinder, as in a slide-valve steam engine. This piston valve is operated from the cam shaft by an eccentric,



THE KOERTING ENGINE WITH BLOWER IN TANDEM

which can be thrown in or out of gear like a clutch. Filling the cylinder with air twice is generally sufficient for starting up, after which the engine runs itself. No existing type of engine can be started with equal certainty and rapidity.

The power cylinder and piston are cooled by circulating water, which in the case of the piston enters the tube carried through the crosshead pin and hollow piston rod, and returns the same way, but on the outside of the tube. The stuffing boxes in the cylinder heads are surrounded by water. The cylinder walls also are cooled throughout except at the middle where the exhaust slots are.

Investigations of the heating-up of the main cylinder walls have shown that such is within moderate limits, so that the durability of the cylinder is permanently insured; the average temperature of the walls is lower than in the case of a high-pressure steam engine.

By maintaining the piston cooler than the cylinder, the expansion of the former is under entire control and the result is good running of the engine.

The cylinder is equipped with relief valves which serve also as safety valves. Hand-hole plates are provided for cleaning the exhaust ports. Experience has shown, however, that the inside of the cylinder remains very clean. It was found that even after long continuous running the exhaust ports especially remained perfectly clean, which is the result of the violent discharge of the burnt gases occurring alternately from right and left. This is an important point, for in other engines where the gases are always blown out in the same direction, scale or crusts of oil form, which become intensely hot and are therefore very apt to cause premature ignition. Formation of the oil crusts is further effectively prevented by the cool piston sliding over the bridges that separate the exhaust ports, thus keeping the temperature of these so low that the adhering lubricating oil does not vaporize.

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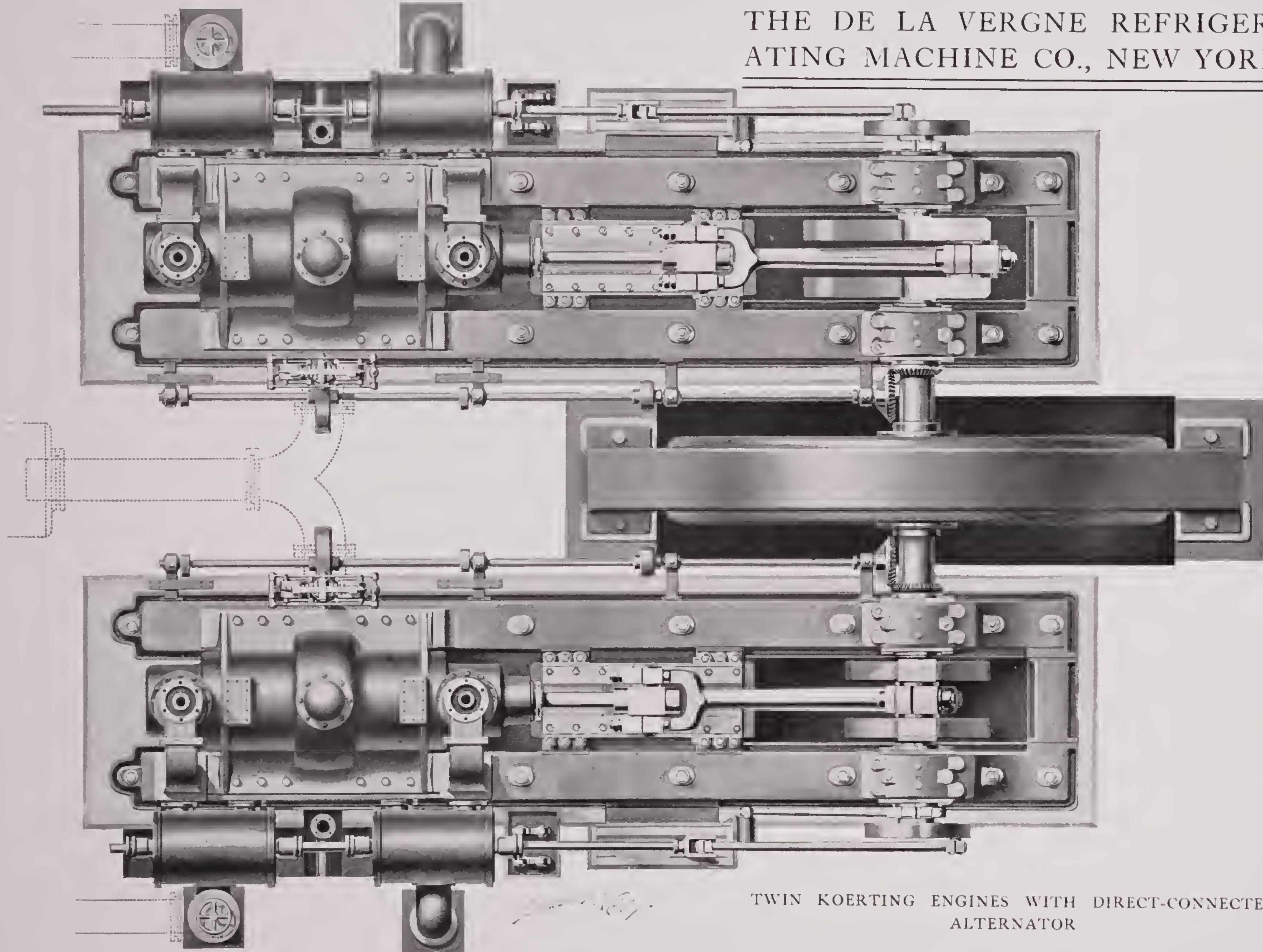
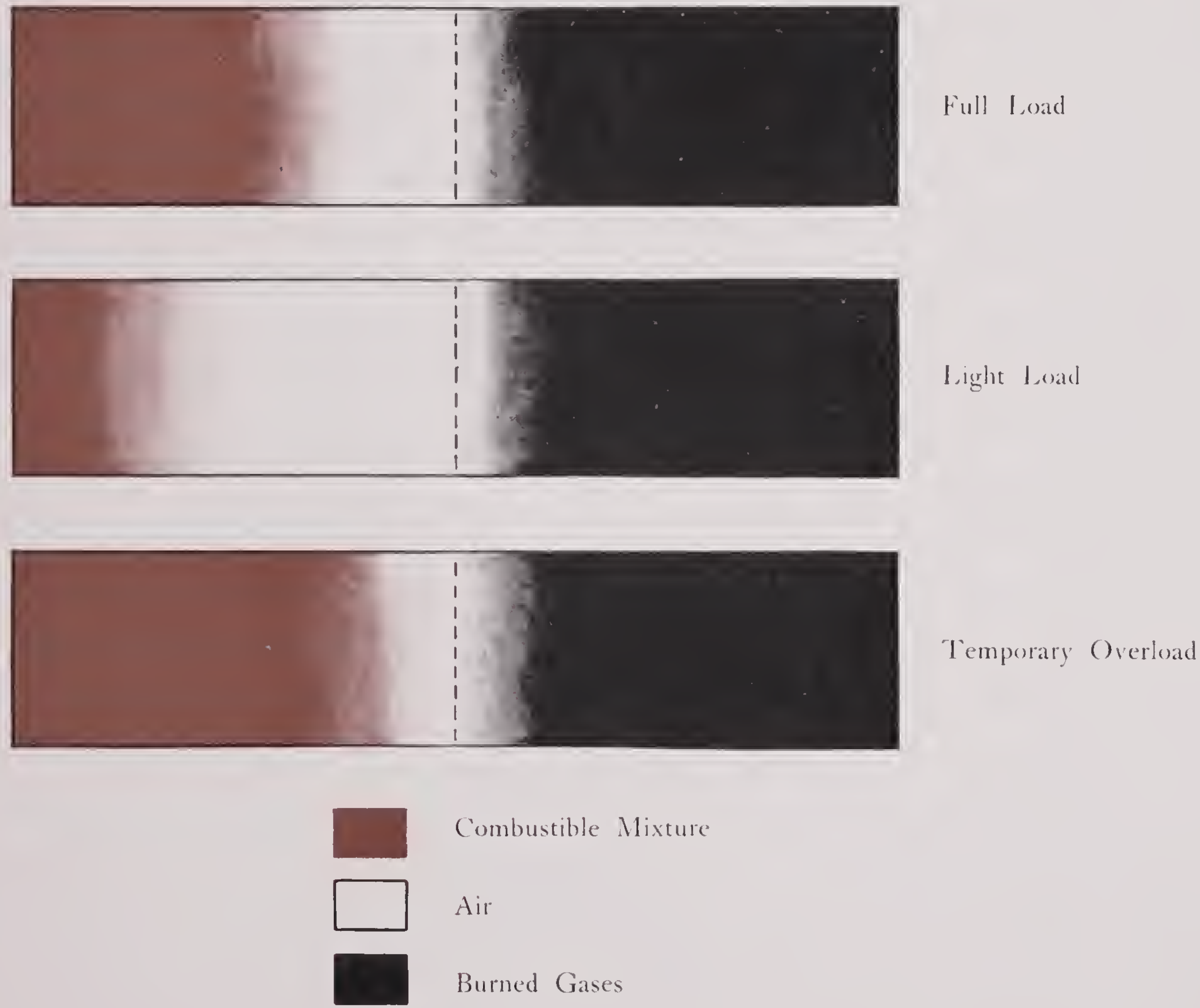


TWIN KOERTING ENGINES WITH DIRECT-CONNECTED ALTERNATOR

THE cut on the opposite page indicates one favorite combination of the Koerting engine, namely, directly connected with an electric generator. In the case of alternating currents the revolving field can be arranged to answer the purpose of a fly-wheel.

The cut on page 16 shows another combination of a Koerting engine driving a horizontal blower in tandem. We also build this engine in combination with vertical blowers. The frame of the blower being astride of the engine frame and its connecting rod driven from the same crank-pin, with or without additional engine as on page 18.

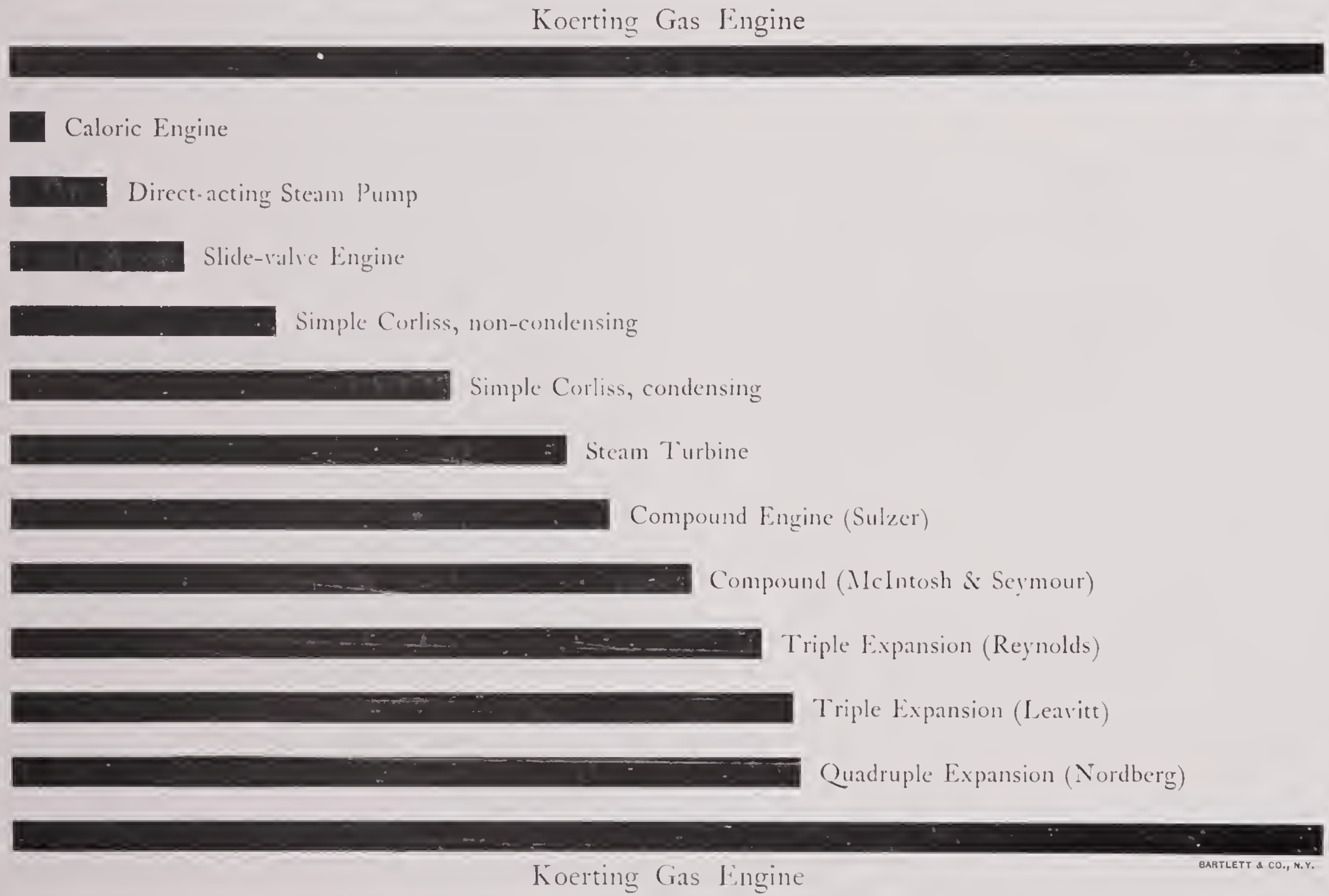


SUCCESSION OF CHARGES IN THE KOERTING ENGINE

THE diagram on the opposite page illustrates the succession of charges in the power cylinder of the Koerting engine. In the upper figure, representing normal conditions, it will be seen that the burnt products have passed through the exhaust port and have been followed by a portion of the pure air, which thus operates as a scavenging charge. The layer of pure air is succeeded by a layer of mixture of constant proportions, in so far as intermixture with the layer of air is prevented.

In the second figure this wad of air is longer and the succeeding wad of mixture is shorter. The mixture, however, remains near the ignition end of the cylinder and maintains substantially the proper proportions for easy ignition.

The third figure illustrated the means of obtaining an overload. In this case the wad of air is shortened and the wad of mixture lengthened beyond their normal length. This overload involves the risk of a small loss of the mixture through the port, and is intended to be used temporarily only. It is a distinctive and very valuable characteristic of the Koerting engine.



RELATIVE THERMAL EFFICIENCY OF VARIOUS ENGINES

THE diagrams on the opposite page show in a very impressive manner the superior thermal efficiency of the Koerting gas engine as compared with even the very highest development in steam engineering.

Professor E. Meyer has experimentally determined a thermal efficiency for the Koerting Double-acting Two-cycle Engine of 38 per cent.

It is with extreme difficulty that the thermal efficiency of a multiple-cylinder steam engine can be made to exceed 22 per cent.

It would seem, therefore, that the future of the gas engine is fully assured.